

Process based Models

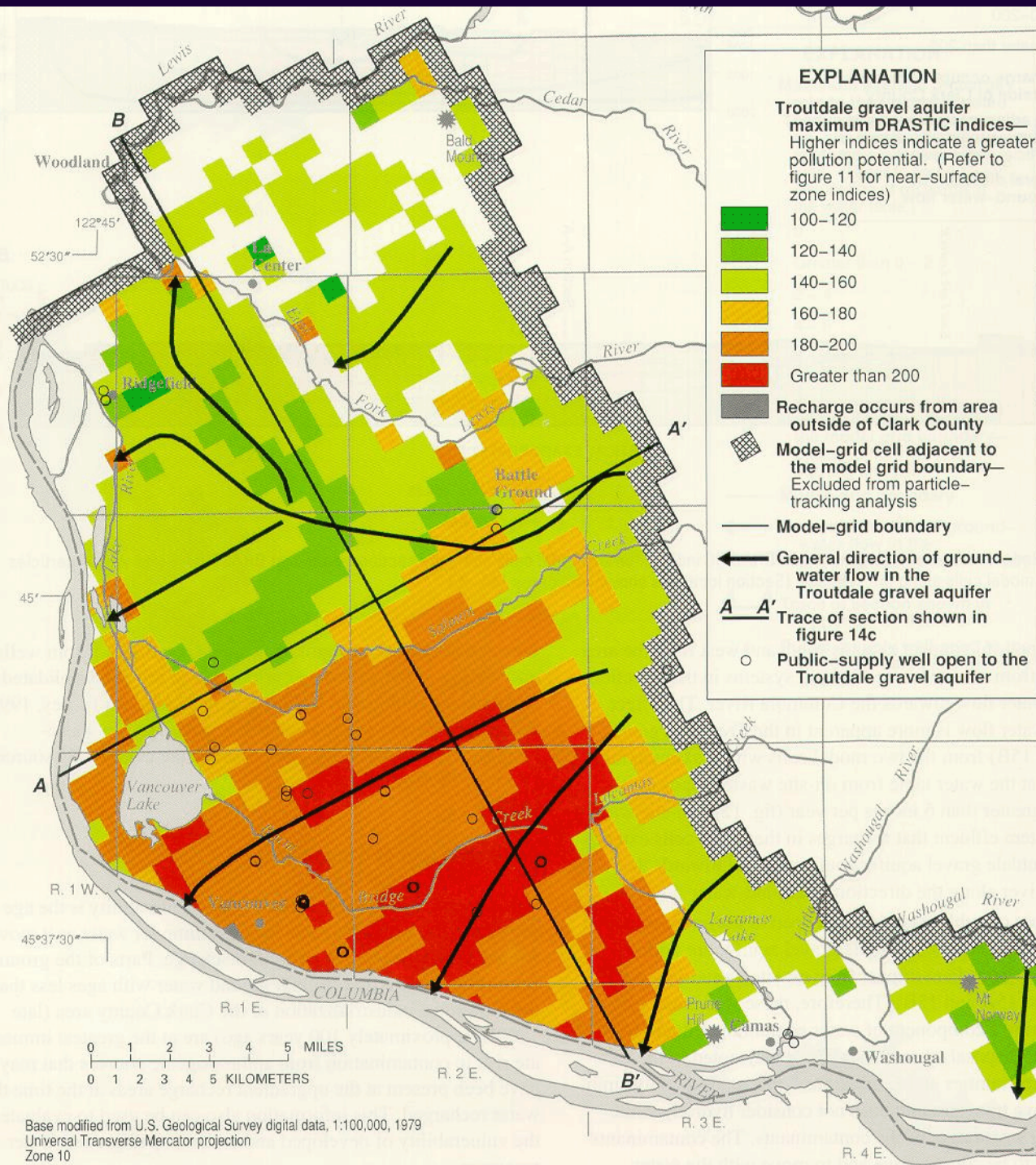
Recharge Areas & Recharge Area Vulnerability

from:
USGS Water Supply Paper 2488, 1998

© Thomas Harter, University of California, Davis, 2009

Process based Models

Final Product: Aquifer Vulnerability



from:
USGS Water Supply Paper 2488, 1998

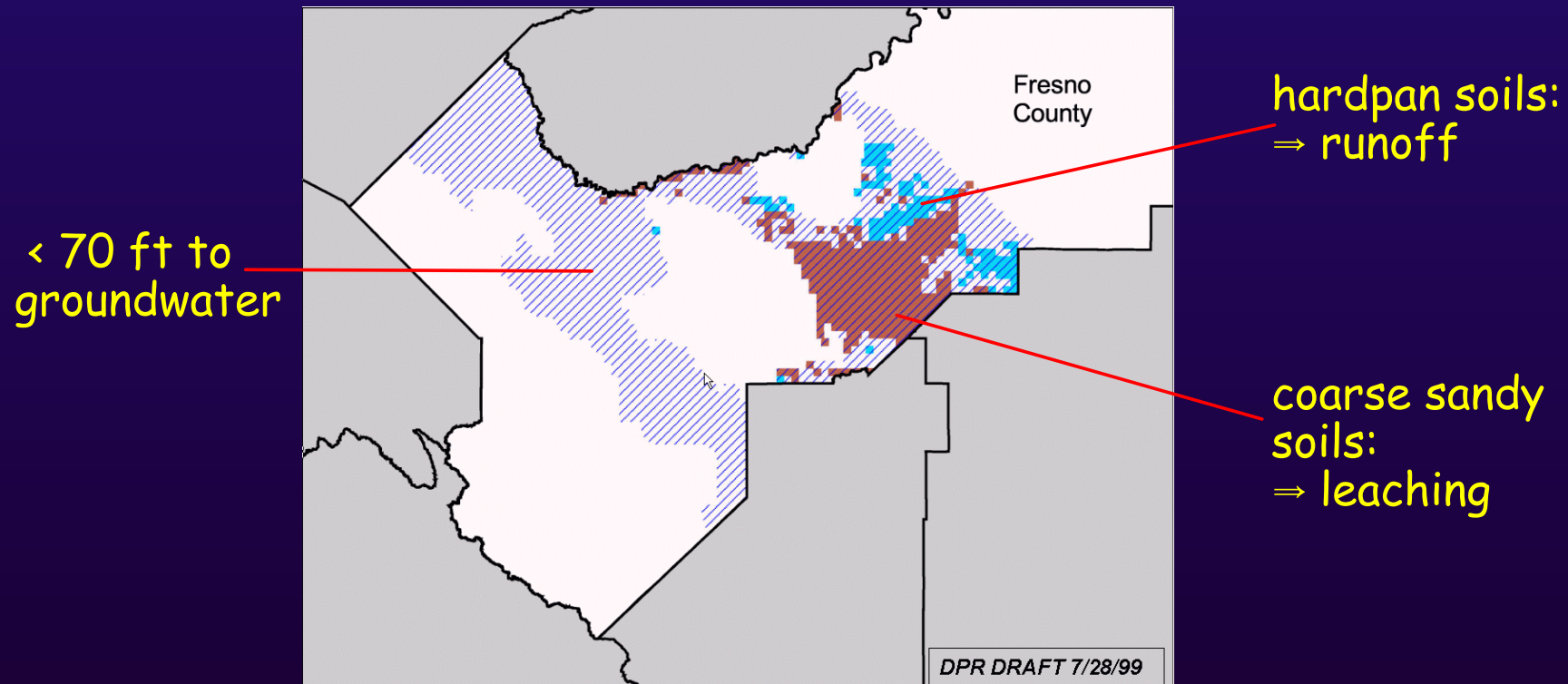
Statistical Methods

- Establish statistical relationship between:
- Evidence of aquifer vulnerability/contamination (e.g., nitrate, pesticide, TDS) and:
- Factors controlling aquifer vulnerability
- Methods:
 - Correlation analysis
 - Analysis of Variance
 - Cluster analysis
 - Discriminant analysis
 -

Statistical Methods

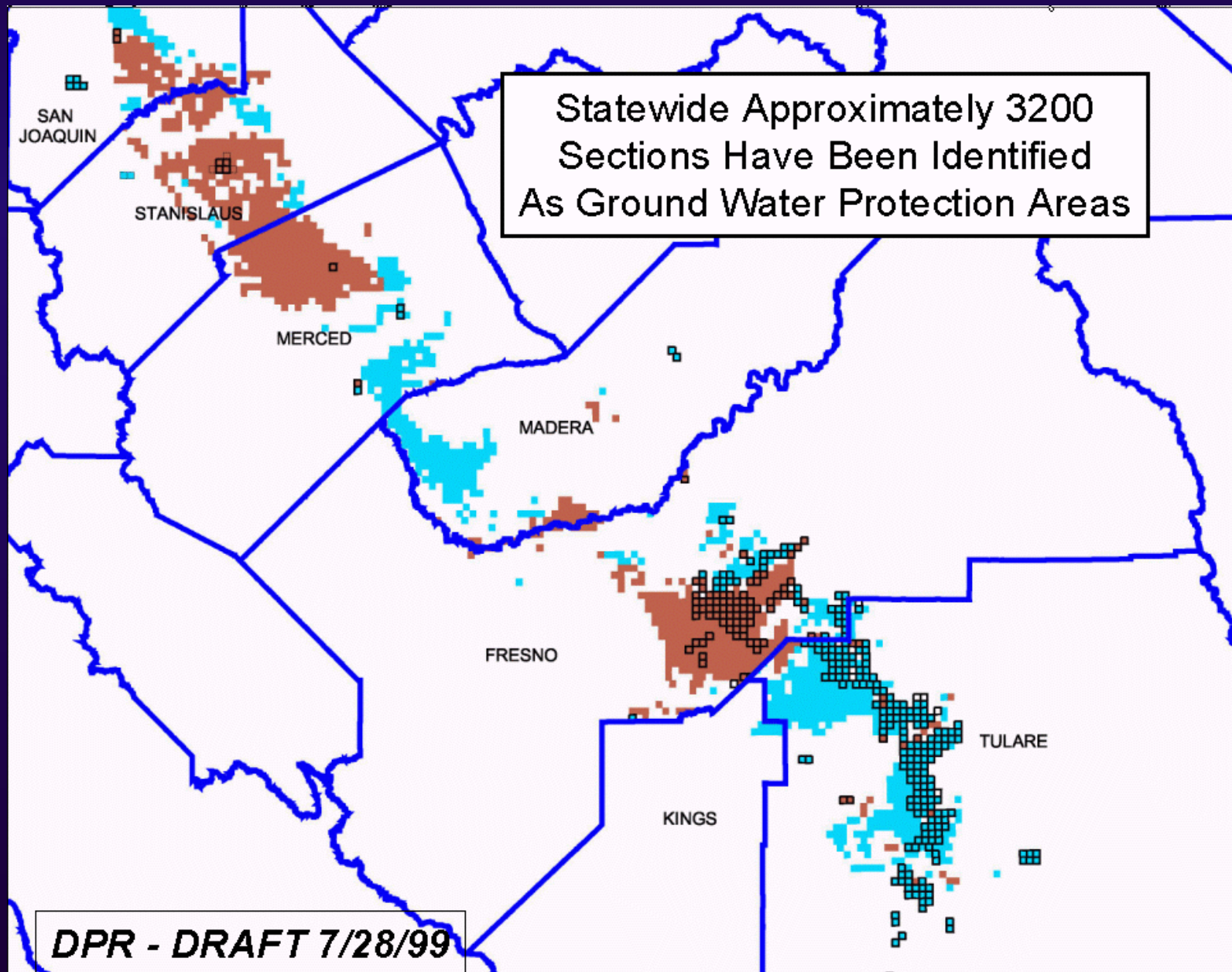
Example: Dept. Pesticide Regulation "Groundwater Protection Zone" Mapping

- Depth to groundwater
- Soil type
- Presence of hardpan



Statistical Method

DPR's "Groundwater Protection Zones"



Statistical Methods

Nitrate Vulnerability (Nolan et al., 2002)

- What is the risk (probability) in a given 1 square mile area that groundwater has elevated (> 4 mg N/L) nitrate-N?
- Focused on recent (10-20 year old, shallow) groundwater
- Logistic regression:

% probability of N exceedance
= f(explanatory factors)

$$\text{Log} (p / (1-p)) = a + b \text{ Var1} + c \text{ Var2} + d \text{ Var3} \dots$$

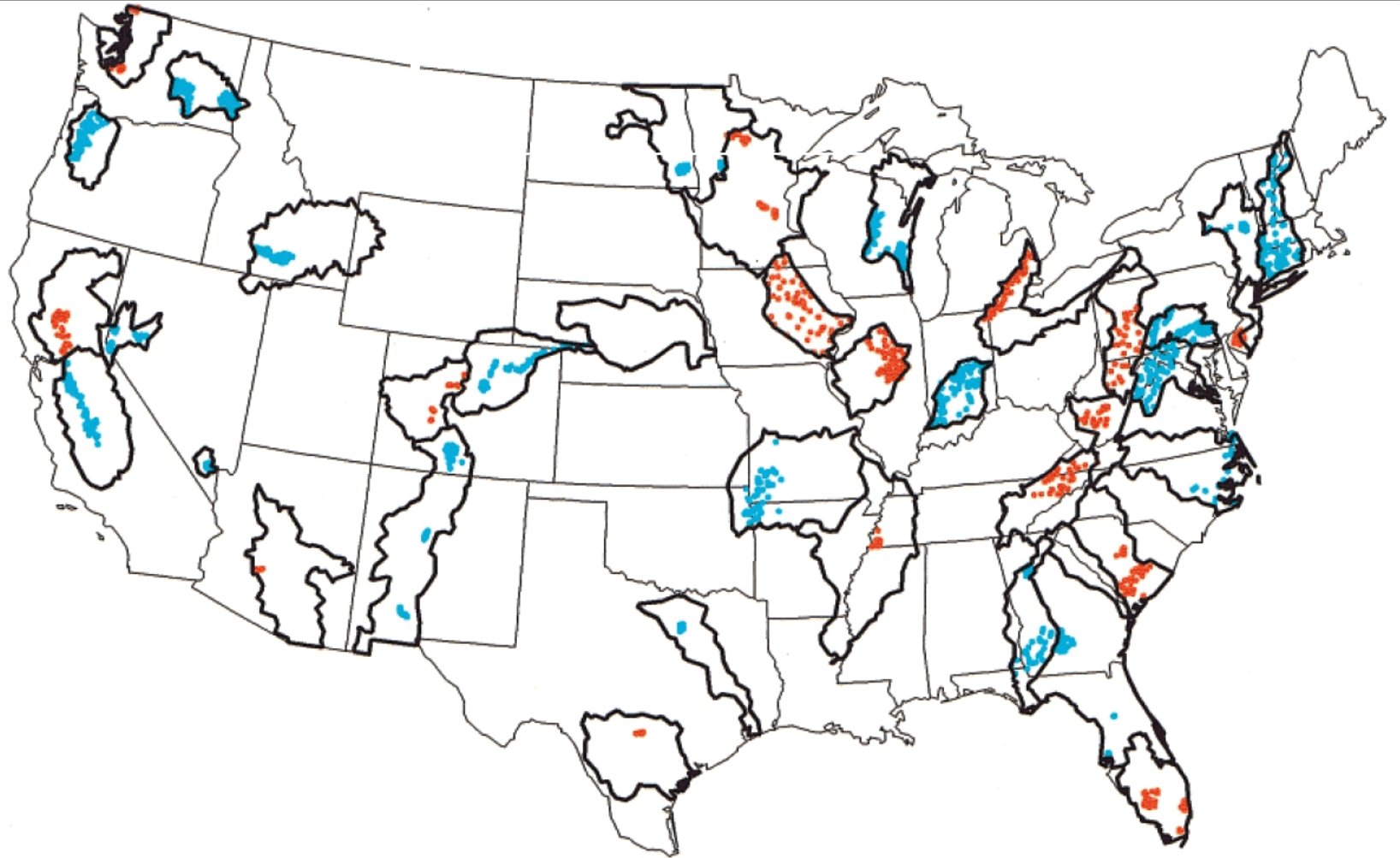
Statistical Methods

Nitrate Vulnerability (Nolan et al., 2002)

- Explanatory factors:
 - 1992 fertilizer N (kg/ha), by county, farm vs. urban
 - % cropland-pasture
 - population density (1990) [surrogate for septic tanks, sewer exfiltration, domestic animals]
 - % well-drained soils (STATSGO hydrologic groups A and B in an area)
 - depth to seasonally high water table
 - presence or absence of unconsolidated sand and gravel aquifers
- Non-significant explanatory factors:
 - Animal population density in counties
 - Total N (manure, fertilizer, atmospheric N)
 - Organic matter in soils
 - Woodland-to-cropland ratio
 - Depth to well-screen
 - Mean annual precipitation 1961-90

Statistical Methods

Nolan et al., 2002:
nitrate dataset to build the regression model

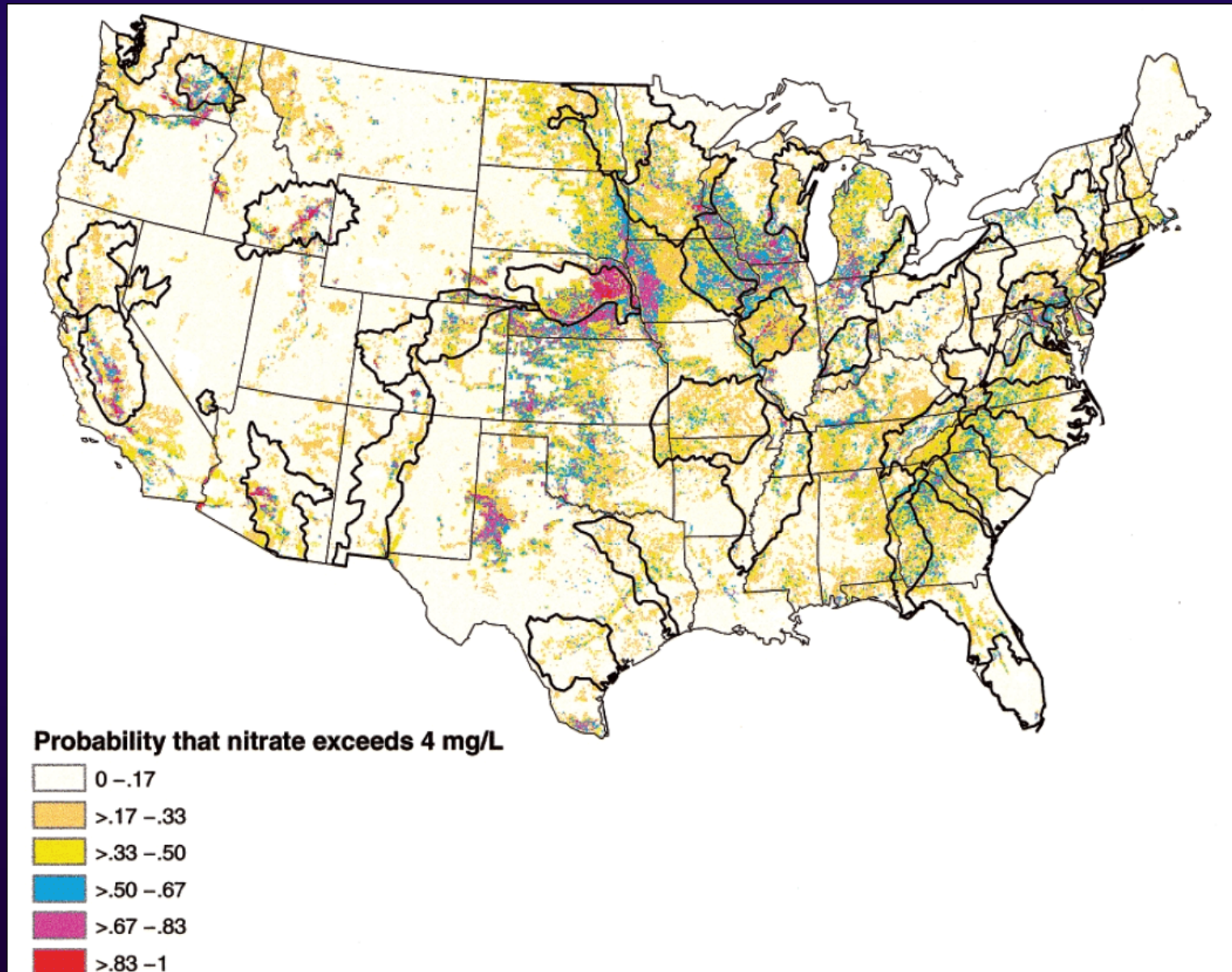


Distribution of wells for calibration and validation

- Sampled well from 1991 NAWQA study unit used for calibration
- Sampled well from 1994 NAWQA study unit used for validation

Statistical Methods

Nolan et al., 2002:
U.S. Nitrate Vulnerability Map



Statistical Methods

Nolan et al., 2002:
U.S. Nitrate Vulnerability Map

